Original Article

Comparison of Airtraq™, McCoy™ and Macintosh laryngoscopes for endotracheal intubation in patients with cervical spine immobilisation: A randomised clinical trial

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ABSTRACT

Background and Aims: The study aimed at comparing the performance of the novel optical Airtraq™ laryngoscope with the McCoy™ and conventional Macintosh laryngoscopes for ease of endotracheal intubation in patients with neck immobilisation using manual inline axial cervical spine stabilisation (MIAS) technique. **Methods:** Ninety consenting American Society of Anaesthesiologist's physical status I–II patients, aged 18–60 years, scheduled for various surgeries requiring tracheal intubation were randomly assigned into three groups of thirty each to undergo intubation with Macintosh, Airtraq™, or McCoy™ laryngoscope with neck immobilisation by MIAS technique. The ease of intubation based on Intubation difficulty scale (IDS) score, Cormack-Lehane grade of glottic view, optimisation manoeuvres and impact on haemodynamic parameters were recorded. Statistical analysis was performed with ANOVA and Bonferroni correction for *post hoc* tests. **Results:** All patients in three groups had a comparable demographic profile and were successfully intubated. The Airtraq™ laryngoscope significantly reduced the IDS (mean – 0.43 ± 0.81) as compared with both McCoy™ (mean – 1.63 ± 1.49, $P = 0.001$) and Macintosh laryngoscope (mean –2.23 ± 1.92, $P < 0.001$) and improved the Cormack-Lehane glottic view (77% grade 1 view and no patients with grade 3 or 4 view). There were less haemodynamic variations during laryngoscopy with the Airtraq™ compared to the Macintosh laryngoscope, but there was not between the Airtraq™ and McCoy™ laryngoscope groups. **Conclusion:** In patients undergoing endotracheal intubation with cervical immobilisation, Airtraq™ laryngoscope was superior to the McCoy™ and Macintosh laryngoscopes, with greater ease of intubation and lower impact on haemodynamic variables.

Key words: Airtraq™, airway management, cervical immobilisation, McCoy™, Macintosh laryngoscope

INTRODUCTION

Airway management is considered a major responsibility and vital skill for anaesthesiologists. Difficult or unsuccessful tracheal intubation is one of the important causes for morbidity and mortality in both emergency and operative settings.[1] Laryngoscopes play an important role in the administration of general anaesthesia and in securing the airway in emergency conditions. They range from simple rigid scopes to complex fibreoptic video devices. With the advances in technology, new devices are available for airway management. The Airtraq™ (Prodol Meditec SA, Vizcaya, Spain) is a novel optical laryngoscope designed to facilitate management of normal and

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difficult airways. As a result of the exaggerated curvature of the blade and the internal arrangement of optical components, a view of the glottis is provided without alignment of oral, pharyngeal and tracheal axes. The blade of the Airtraq™ consists of two side by side channels; one channel acts as a conduit through which tracheal tube is passed while the other has a series of lenses, prisms and mirrors with a built in antifog system which transmit the image from the illuminated tip to the proximal viewfinder.[2,3]

The McCoy™ laryngoscope (Penlon) is designed to elevate the epiglottis with its hinged tip and requires less lifting force during laryngoscopy.[4] It is frequently used to facilitate tracheal intubation when the view of the glottic opening is restricted.[5]

Manual inline axial stabilisation (MIAS) of the cervical spine is widely used in clinical practice in patients with actual or suspected cervical spinal injuries, to reduce the risk of cord injury during tracheal intubation.[6]

This randomised, prospective study was designed to determine the relative effectiveness of Airtraq™ over conventional Macintosh and McCoy™ laryngoscope in patients undergoing tracheal intubation with MIAS technique. We hypothesised that Airtraq™ with its anatomical curvature would perform better while intubating patients by MIAS technique.

METHODS

After obtaining approval by the hospital Research Ethics Committee, and written informed patient consent, ninety American Society of Anesthesiologists physical status I–II patients, aged 18–60 years, scheduled for various elective surgeries under general anaesthesia requiring tracheal intubation were enrolled in this single-blinded, prospective randomised clinical trial.

Patients with risk factors for difficult intubation (modified Mallampati class III and IV, thyromental distance <6 cm, interincisor distance <3 cm, body mass index more than 30 kg/m^2), risk for gastric aspiration, relevant drug allergy were excluded from the study. All data were collected during preanaesthetic evaluation by an independent observer.

Patients were randomised to undergo tracheal intubation based on the allocation sequence generated using online randomisation software (http://www.randomization.com), with Macintosh, McCoy™ or Airtraq™ laryngoscope, and the allocation concealed in sealed envelopes, which were opened after patient consent had been obtained. In the operation theatre, electrocardiogram, pulse oximetry, noninvasive blood pressure and end tidal carbondioxide monitors were attached. Patients were preoxygenated with 100% oxygen for 3 min. Intravenous premedication was given with injection glycopyrolate 10 μg/kg, injection midazolam 0.05 mg/kg and injection fentanyl 2 μg/kg. Intravenous induction was done with injection propofol 2 mg/kg. All patients were manually ventilated and injection vecuronium 0.1 mg/kg intravenous was administered as muscle relaxant. After the onset of neuromuscular block, the neck was immobilised by MIAS, which was achieved by an assistant standing on the side of bed and using fingers and palms of both hands to stabilise patient's occiput and mastoid process.

Group A patients were intubated using conventional Macintosh laryngoscope, Group B with McCoy™ laryngoscope and Group C with optical Airtraq™ laryngoscope by the same anaesthesiologist who was experienced in using all three laryngoscopes. An intubation attempt was defined as one advancement of the tube in the direction of the glottis during direct laryngoscopy. A maximum of three attempts at intubation were permitted after which it was considered as failed intubation attempt and the anaesthetist utilised an alternative predetermined rescue laryngoscope. Following intubation, patients were mechanically ventilated for the duration of the surgical procedure and anaesthesia was maintained using isoflurane in a mixture of oxygen and nitrous oxide. During the 5 min, period immediately following tracheal intubation, no other interventions were performed, nor were any drugs administered. Subsequent management of the patient was left to the discretion of anaesthesiologist providing care for the patients.

The primary objective was assessment of the difficulty of tracheal intubation based on intubation difficulty scale (IDS) score [Table 1], a quantitative scale of difficult intubation with seven variables assessing the complexity of tracheal intubation, developed by Adnet *et al*.[7] An IDS score of zero implies the best intubation conditions, while progressively more difficult tracheal intubations result in higher scores.

The secondary objectives were glottic view according to Cormack-Lehane grading, number of optimisation

techniques (use of bougie, different size blade, stylet), impact on haemodynamic variables such as heart rate, mean arterial blood pressure, and oxygen saturation, which were recorded preintubation, 1, 3 and 5 min after intubation. Preintubation values were taken as baseline measurements. Any adverse events such as arrhythmias, oral trauma, fall in saturation were recorded.

The sample size estimation was based on our primary objective, namely the IDS score. Based on prior study,[8] the clinically significant change in mean IDS score between groups was considered as 2.0 with expected standard deviation of 2.25. Using $\alpha = 0.05$ and power of study being 80%, we estimated that 27 patients were required in each group. Thus, ninety patients with thirty in each group were enrolled in the study. Statistical analysis was performed using SPSS software version 20. The patients demographic profile, IDS score, Cormack-Lehane grade, number of optimisation techniques and haemodynamic parameters were analysed using ANOVA and each device was compared with other two using Bonferroni *post hoc* test. All values are expressed as mean ± standard deviation and categorical data presented as numbers and as frequencies $P < 0.05$ was considered statistically significant.

RESULTS

A total of ninety patients were enrolled in this prospective clinical trial. Demographic profile and airway parameters [Table 2] were comparable between the groups. All patients were successfully intubated.

The IDS scores [Table 3] were significantly lower in patients intubated with the Airtraq™ (mean 0.43 ± 0.81) than those intubated with either the Macintosh (mean 2.23 ± 1.92, $P < 0.001$) or the McCoy™ (mean 1.6 ± 1.49, $P = 0.001$) laryngoscope. Optimisation manoeuvres required to facilitate tracheal intubation were more with the Macintosh and McCoy™ laryngoscopes compared with the Airtraq™ laryngoscope.

A significantly better Cormack and Lehane glottic view was obtained at laryngoscopy with less optimisation maneuvers in the Airtraq™ group ($P < 0.01$) compared with the Macintosh and McCoy™ laryngoscope group. In Airtraq™ laryngoscope group 77% patients had Cormack and Lehane grade 1 view of glottis with no patients having grade 3 or 4 view as compared to McCoy™ with 53% had grade 1 and Macintosh laryngoscope group where 27% had grade 1 Cormack and Lehane view and 10% patients had grade 3 view of glottis [Table 4].

Tracheal intubation with Macintosh laryngoscope resulted in significant increase in heart rate and mean arterial blood pressures, compared to preintubation values in contrast to Airtraq™ and McCoy™ laryngoscope group [Figures 1 and 2].

There was no incidence of dental or other airway trauma in any of the groups. There was no difference

Table 1: Intubation difficulty scale

Variables	Score
Number (n) of intubation attempts >1	*N*
Number (n) of operators >1	*N*
Number of alternative intubation techniques used (like bougie, stylet, different size blade, endotracheal tube, etc.)	*N*
Glottic exposure - Cormack and Lehane grade of laryngoscopy 1/2/3/4	0/1/2/3
Lifting force required for laryngoscopy	0 - normal 1 - increased
Necessity of external laryngeal pressure	0 - not applied 1 - applied
Position of vocal cords at intubation	0 - abduction/not visualised 1 - adduction

Table 2: Patient characteristics

Parameters	Macintosh group	McCoy™ group	Airtraq™ group
Age	37.37±11.32	35.28±14.2	33.37±12.07
Sex (male/female)	11/19	12/8	13/17
ASA (I/II)	16/14	18/12	18/12
MPC (I/II)	8/22	10/20	9/21
™D (cm)	6.82±0.28	7.0±0.24	6.96±0.32
IID (cm)	3.64±0.27	3.4±0.31	3.7±0.42
BMI (kg/m^2)	23.17±2.07	23.45±2.21	22.74±2.17

Data are reported as mean±SD. SD – Standard deviation; ASA – American Society of Anaesthesiologists; MPC –Modified Mallampati classification; ™D – Thyromental distance; IID –Inter incisor distance; BMI – Body mass index

Table 3: Data of laryngoscopy with each intubation device

Parameters assessed	Macintosh	McCoy™	Airtraq™
Overall success rate, *n* (%)	30 (100)	30 (100)	30 (100)
IDS	2.23±1.92	1.6±1.49	0.43±0.81
IDS (number of patients)			
0	6	8	22
1	8	8	4
≥2	16	14	4
Cormack Lehane grade			
1	8	16	23
2	19	14	7
3	3	0	0
Number of patients with optimisation manoeuvres	10	6	1

Data are reported as mean±SD. SD – Standard deviation; IDS – Intubation difficulty scale

Table 4: Distribution of subjects according to intubation difficulty scale score

Parameters	Macintosh group (*n*=30)	McCoy™ group (*n*=30)	Airtraq™ group (*n*=30)
Number of patients in whom intubation required more than one attempt	7	4	3
Number of patients in whom intubation required more than one operator	0	0	0
Number of patients in whom alternative intubation technique were used	10	6	
Cormack and Lehane Grade 1/2/3/4	8/19/3/0	16/14/0/0	23/7/0/0
Number of patients in whom increased lifting force required	14	7	0
Number of patients in whom laryngeal pressure was applied	21	8	1
Number of patients with vocal cord mobility	0	0	0

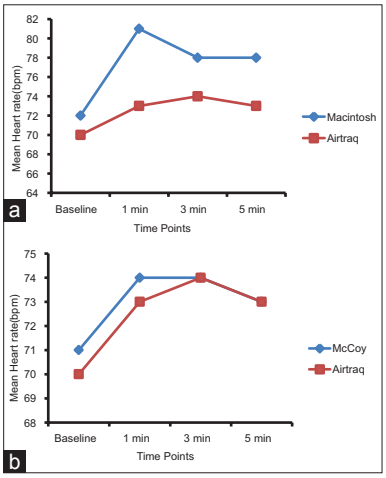

Figure 1: Mean heart rate changes (beats per minute) in response to laryngoscopy and intubation between (a) Airtraq™ and Macintosh group (b) Airtraq™ and McCoy™ group.The data are expressed as mean (SD)

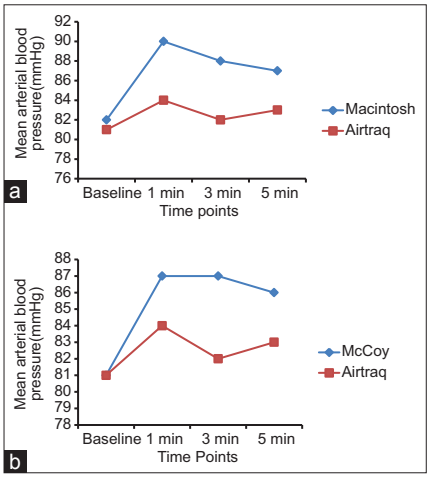

Figure 2: Mean mean arterial pressure changes (mmHg) in response to laryngoscopy and intubation between (a) Airtraq™ and Macintosh group (b) Airtraq™ and McCoy™ group.The data are expressed as mean (SD)

between the groups with regard to the success rate of intubation or adverse events.

DISCUSSION

The findings of our study demonstrate that novel optical Airtraq™ laryngoscope performed better than the hinged tipped McCoy™ and conventional Macintosh laryngoscope in patients with cervical immobilisation by reducing the mean IDS score, and with lesser variations in haemodynamic parameters. Airtraq™ laryngoscope resulted in significantly better glottic view with lower Cormack-Lehane grade and had a statistically significant less optimisation manoeuvres during intubation than Macintosh and McCoy™ group and offered easier intubating conditions.

Management of difficult airway continues to be a challenge even in the hands of most experienced anaesthesiologists despite the invention of many novel airway devices. MIAS is widely used in clinical practice in patients with actual or suspected cervical spinal injuries to reduce the risk of cord injury during tracheal intubation and has become established standard of care for head trauma patients.[9] A key concern is, when the neck is immobilised by MIAS, it makes more difficult in aligning the oral, pharyngeal and laryngeal axes to visualise the cords.[10,11]

The factors that influence the magnitude of haemodynamic changes during laryngoscopy are the duration of laryngoscopy and intubation, type of laryngoscope[12] used, anaesthetic agent and the depth of anaesthesia. The pressor response following laryngoscopy can lead to complications such as myocardial ischaemia, cardiac failure, increase in intracranial pressure and intraocular pressure.[13,14]

A study comparing Macintosh and Airtraq™ laryngoscopes in patients with cervical spine immobilisation reported significantly higher IDS scores in Macintosh group compared to the Airtraq™

group, which was similar to our results.[3] A better success rate of intubation was reported[15] with Airtraq™ in patients with cervical immobilisation with the application of rigid cervical collar. In our study MIAS technique was used instead of cervical collar, which restricts mouth opening. A recent study reported that Airtraq™ produces 66% less movement of the cervical spine during MIAS when compared with the Macintosh and further underlines the utility of this device in this setting.[16]

Since the technique of MIAS makes glottic view difficult by increasing the Cormack Lehane grade, our study highlights the use of Airtraq™ over conventional laryngoscope with 77% grade 1 glottic view. These results are supported by studies comparing the laryngeal view during tracheal intubation using Airtraq™, McCoy™ and Macintosh laryngoscopes which concluded that Cormack-Lehane grade was statistically significantly lower with the Airtraq™ device.[17,18] It is reported that the intubation with Airtraq™ did not require any optimisation manoeuvres, in comparison to Macintosh group in a similar study.[19] Our study highlights similar findings in Indian population while comparing conventional Macintosh, McCoy™ and novel Airtraq™ laryngoscope.

The haemodynamic findings in our study was comparable to other studies using Airtraq™ laryngoscope in different scenarios like in patients with normal airway,[2] anticipated difficult airway[20] and also in a comparative study between the use of Macintosh laryngoscope and Airtraq™ in patients with cervical spine immobilisation, which reported statistically significant increase in both heart rate and mean arterial pressure in Macintosh group than Airtraq™ group.[3] Oxygen saturation showed no significant difference between the groups.

The internal arrangements of the high definition optical give a high quality and wide angle view of glottis, surrounding structures and the tip of the endotracheal tube. The exaggerated anatomical curvature of the blade of Airtraq™ laryngoscope does not require alignment of oral, pharyngeal and laryngeal axes, thus resulting less lifting force needed during laryngoscopy and less haemodynamic response during intubation. The recent guidelines published by the Difficult Airway Society for the management of difficult intubation advocates consideration of alternative video laryngoscopes in the primary intubation plan.[21]

Laryngoscopy and tracheal intubation of patients with head injury with potential cervical spinal injury is a high-risk procedure. MIAS reduces segmental angular rotation and distraction and therefore potentially protects the patients from further injury. With the advances in technology, a large number of novel laryngoscope devices have been available in recent years, despite having a relatively limited base supporting their use in different clinical situations. Our study highlights the clinical utility of optical Airtraq™ laryngoscope in patients undergoing intubation with MIAS.

We acknowledge that there are few limitations with regard to our study. Blinding the anaesthesiologist involved in intubation was not possible and measurements like laryngoscopic grading and lifting force applied are subjective in nature. In our study all the three devices were used by experienced anaesthesiologist and the results are variable in the hands of inexperienced ones.

CONCLUSION

The novel optical Airtraq™ laryngoscope provides better intubation conditions with greater ease of intubation, better glottic view and lesser haemodynamic alterations during laryngoscopy as compared to McCoy™ and Macintosh laryngoscope. This study demonstrates the superiority of novel optical Airtraq™ laryngoscope over the McCoy™ and the conventional Macintosh laryngoscope in patients with cervical spine immobilisation.

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Conflicts of interest

There are no conflicts of interest.

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